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FIRE WEATHER IN THE SOUTHEAST

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Value of Timberland in the South

Many people do not realize the great natural resource in forestry that lies in the South, so it will be beneficial to preface this discussion with statistical emphasis concerning this value.

These remarks pertain principally to Alabama, since that is the writer's chief area of interest, but many observations about this state are applicable to the entire southeastern region.

Forest lands in Alabama cover two-thirds of the State. This comprises twenty-two million acres. Ten pulpmills are now in operation, and four additional mills are being built. Alabama's wood-based industries are second only to metals in annual dollar output. It is estimated that this industry brings 550 million dollars to the State. Timberland and the industry it supports provides jobs for more than 100,000 people - one out of every five wage earners. For every dollar the owner gets for stumpage, more than 17 dollars is added in processing and distribution by the time the wood reaches the consumer. Alabama's pulpwood production ranks second in the nation with an increase of 10 million dollars in 1964. The South's pulpwood production in 1964 was 61 percent of the nation's total, totaling 580 million dollars. Unfortunately, however, the South wears the label of having more forest fires per year than any other area of the country with the occurrence of almost 93,000 forest fires in 1963 burning over four million acres.

The Forest Meteorologist has a responsible job to do in backing this massive industry with detailed weather information and consultation for use in fire control, prescribed (programmed) burning, insect control and seeding.

Forecast Meteorological Elements

A general picture of the meteorological elements in which fire weather forecasters are interested can be obtained by examining the forecast form presently being used in Alabama. Forecast forms vary from state to state but all contain essentially the same information. As one can see, information given is of considerable detail.

The first element is precipitation. Usually this term is broken down into type, coverage, duration, and amount. The amount of precipitation is quite important for not only does it affect fire danger and harvesting operations but other phenomenon as well.

The wind direction and speed is important in fire danger and also in planning prescribed burning. In order that a wind speed forecast be useful, the forecast should fall within an interval of two to three miles per hour of the observed value. This is especially true of today's forecast. Any erratic or gusty wind conditions are important to note.

DCF-149
(Revised 9-16-64)

FIRE-WEATHER FORECAST
ALABAMA DEPARTMENT OF CONSERVATION - DIVISION OF FORESTRY

For District_____ Date_____

TODAY

Weather and Clouds_____

Amount of Precipitation_____

Wind Direction and Speed_____

Lowest Fuel Moisture_____

Lowest Relative Humidity_____

Highest Temperature_____

TONIGHT

Weather and Clouds_____

Amount of Precipitation_____

Wind Direction and Speed_____

Highest Fuel Moisture_____

Highest Relative Humidity_____

Lowest Temperature_____

TOMORROW

Weather and Clouds_____

Amount of Precipit_____

Wind Direction ar_____

Lowest Fuel Moi_____

Lowest Relative Hu_____

Highest Temperature_____

Remarks_____

Forecasts are issued from WBAS, Montgomery, for nine Alabama Forest Districts daily at 9:30 a.m. and are updated as needed.

1 p.m. reports of rain, wind, build-up index, fine-fuel moisture, and spread index at twelve locations keep the forecaster advised of forest weather conditions.

A description of each forecast element that is contained in the forecast follows. If two or more elements coexist, the dominating one (the one most important to fire behavior) will be forecast.

I. Weather and Clouds
   A. Clouds
      1. Clear - 2/10 or less sky covered by clouds.
      2. Partly cloudy - 3/10 to 7/10 of sky covered by clouds.
      3. Cloudy - 8/10 or more of sky covered by clouds.
      4. Increasing - progressive increase of cloudiness.
      5. Decreasing - progressive decrease of cloudiness.

   B. Weather
      1. Rain or snow (general precipitation, not showery).
         a. Occasional - general precipitation occurring at irregular intervals. Occasional precipitation is not showery.
         b. Continuous - general precipitation occurring without
         b. or nearly without interruption.

      2. Showers and/or thunderstorms.
         a. Few - up to 20% chance to receive measurable precipitation.
         b. Scattered - 21% to 55% chance to receive measurable precipitation.
         c. Numerous - greater than 55% change to receive measurable precipitation

         When thunderstorms are expected to be especially turbulent or violent, the modifying term "severe" is used; otherwise, no modifying term is used.

II. Amount of Precipitation During a Forecast Period.
   A. None
   B. Very light - less than .15 of an inch.
   C. Light - .16 to .40 of an inch.
   D. Moderate - .40 to .75 of an inch.
   E. Heavy - more than .75 of an inch.

III. Wind Direction and Speed.
   The direction is that from which the wind is blowing. The wind speed is that most likely to occur throughout the district measured at the standard 20-foot level in miles per hour. When erratic change in wind speeds that might affect fire behavior is expected, the term "gusts" followed by maximum wind speed will be included.

IV. Fine Fuel Moisture and Relative Humidity.
   The forecasts of fine fuel moisture and relative humidity are for the lowest expected during the day, usually mid-afternoon, and the highest expected during the night, usually near daybreak.

V. Temperature.
   The forecast of temperature is that for the highest expected during the day, usually during mid-afternoon and the lowest expected during the night, usually near dawn.

VI. Remarks.
   Those elements that cannot be expressed by using the above terms and those factors that would be influential concerning detection, behavior and suppression of fires will be expressed in remarks. Each Monday, Wed., and Fri. a general outlook will be included covering the next three days.

One of the basic ingredients of fire danger specification is relative humidity. At low relative humidity the tolerance of forecast error is small. For forecasts to be of use, they should fall within an interval of five percent of the observed value for humidities less than 50 percent and more like three or four percent when humidities are less than 30 percent.

The temperature forecast is put to many uses, including outdoor/indoor planning purposes, however, this item is important in fire danger as well.

Fuel moisture forecasts are made for Alabama forests, but this does not appear to be a general requirement on fire weather forecasters in other states. For some states, visibility forecasts for use in tower and plane observations are included, and in some the height of inversion and wind speed profile is given.

The importance of these weather elements can be emphasized by inspecting some rather interesting findings taken from a case study (1) conducted of the 1963 fall fire season lasting from October 1 through November 25. This involved forest district two in north-central Alabama that surrounds the city of Birmingham. Weather data from the Birmingham Weather Bureau was assumed representative of the study area.

Relative Humidity

Table 1 shows the relation of number of fires 300 acres or above to lowest relative humidity. It shows that most large fires occur only during days of very low relative humidities.

Table 1

No. of fires 300 acres or above	Lowest relative humidity
5	15-20 percent
4	20-25 "
1	25-30 "
1	30-35 "
Total 11	

Figure 1, derived from the same study, shows the relation of the daily number of fires and daily acreage burned to lowest 24-hour relative humidity. Generally, as the lowest 24-hour relative humidity decreases, the daily number of fires and daily acreage burn increases. The maximum values occurring at category 43 to 47 percent reflect the time in which these humidities occurred within the study period. The great majority of days that fell in this humidity category occurred towards the last of the period, thereby receiving the full impact of the accumulative effects of the drought.

Relative Humidity plus other Weather Elements

Another figure, 2, from the same study not only illustrates the importance of relative humidity but also brings in other factors to be considered. In viewing this figure, it is important to note that the number of fires

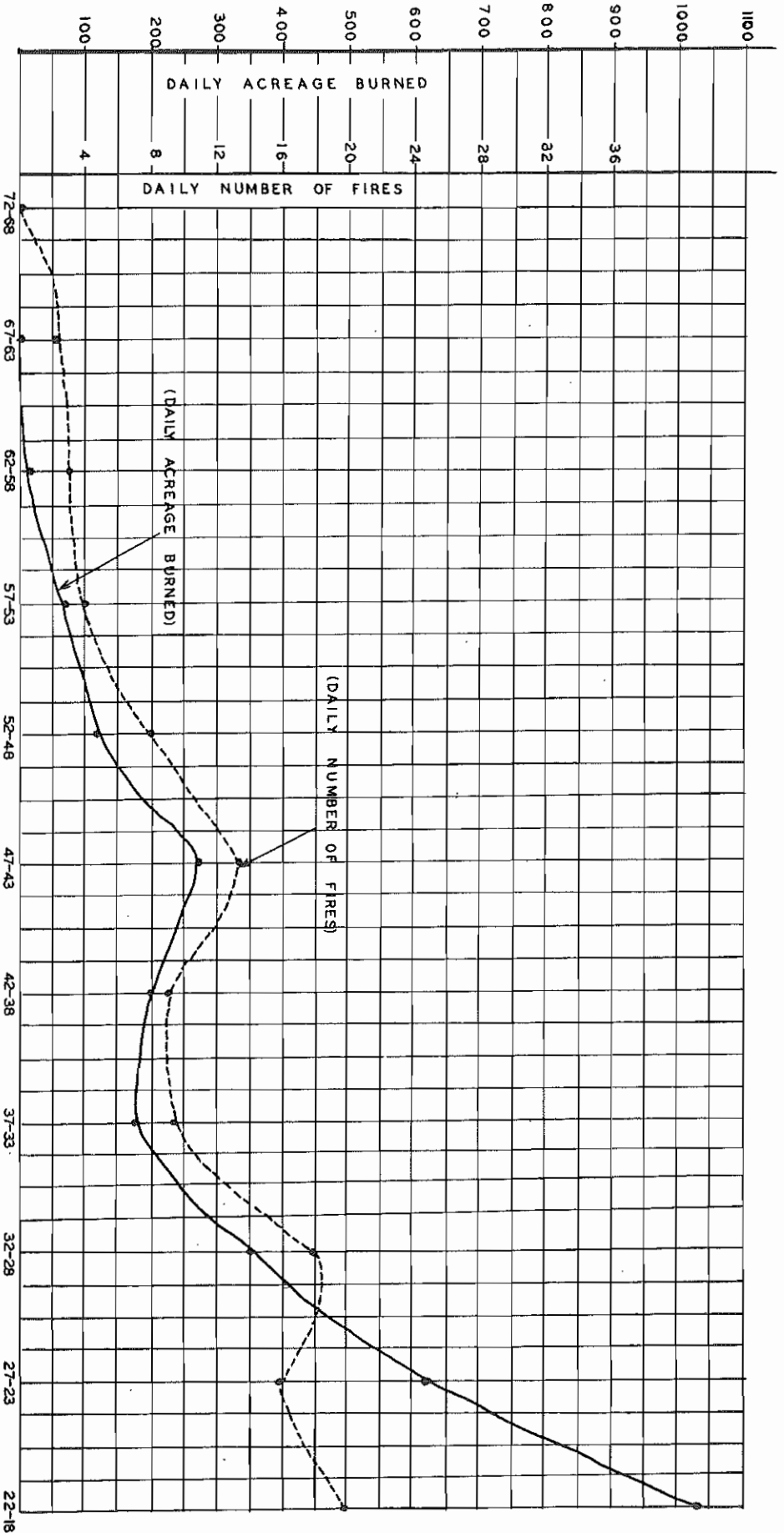

DAILY ACREAGE BURNED
100
200
300
400
500
600
700
800
900
1000
1100
DAILY NUMBER OF FIRES
4
8
12
16
20
24
28
32
36
(DAILY ACREAGE BURNED)
(DAILY NUMBER OF FIRES)
72-68
67-63
62-58
57-53
52-48
47-43
42-38
37-33
32-28
27-23
22-18
LOWEST 24-HOUR RELATIVE HUMIDITY (%)

FIGURE 1

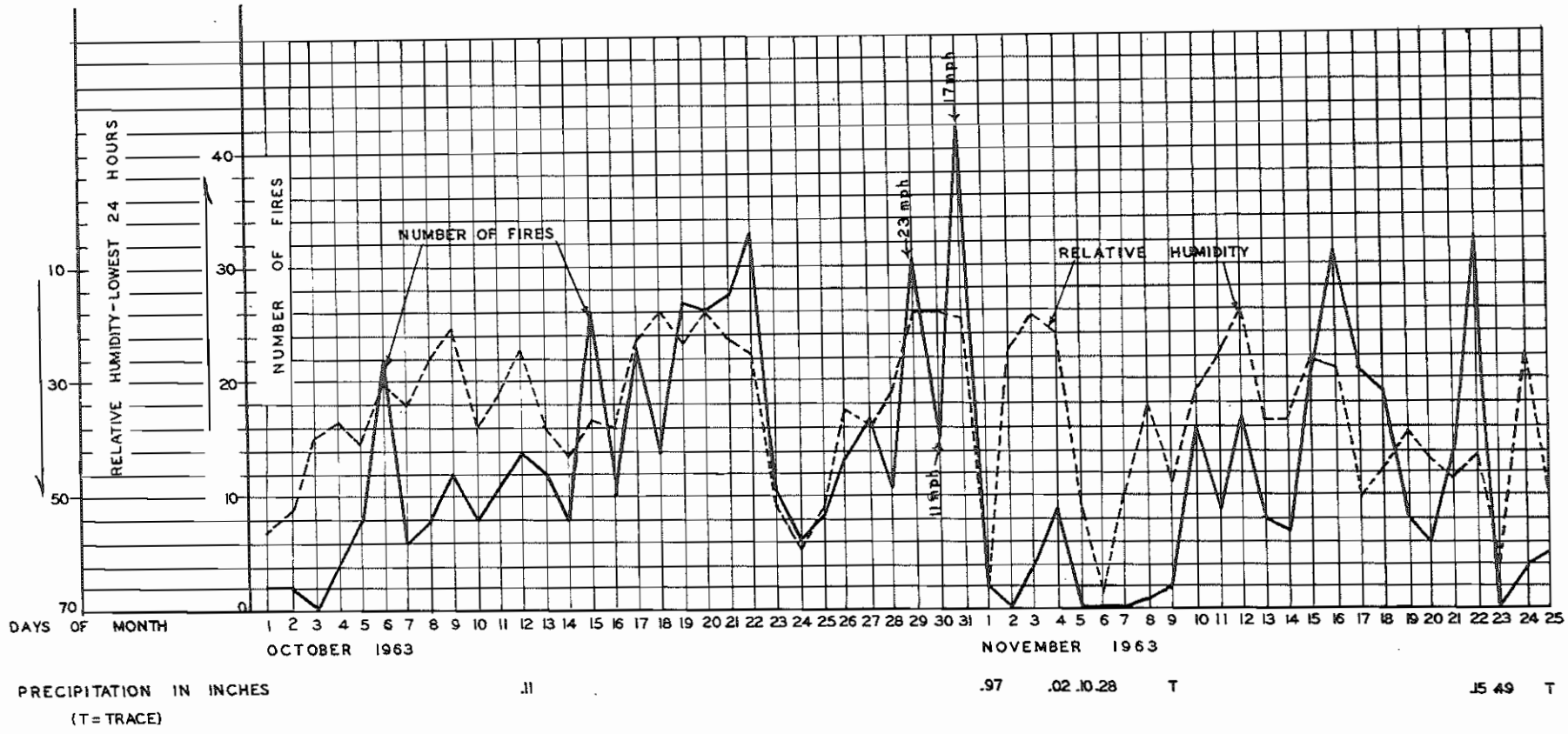


FIGURE 2 FIRE OCCURRENCE AND RELATIVE HUMIDITY

increase on the vertical axis while the relative humidity decreases. This is depicted in such a manner as to give a clear visualization of the positive relation of increase in number of fires to decrease in relative humidity. With a few exceptions the fluctuation in the curves correlates surprisingly well.

The importance of wind speed is evident through the period of December 29, 30 and 31. During these three days humidity remained essentially the same while fire occurrence fluctuated considerably. On December 29, the highest recorded wind was 23 miles per hour dropping to 11 miles per hour on December 30, and increasing to 17 miles per hour on December 31. This fluctuation is in good agreement with fire occurrence with the last day having the greatest occurrence because of the drying effect of the preceeding days.

Small amounts of rain which occurred on several days seem to have had little effect on fire occurrence. Most noticeable are October 12 and November 22. In fact, the third most numerous burn day during this study was November 22, when .15 inch of rain fell. The lowest relative humidity that day was 43 percent, which is not considered dangerously low. The high burn was caused by temperature and winds. The temperature was 22 degrees above normal, which is unusually high, and the fastest recorded wind speed was thirty miles per hour which is the highest recorded speed during this study. These two factors acting together in relation to the accumulative dryness were more than enough to produce high fire burn.

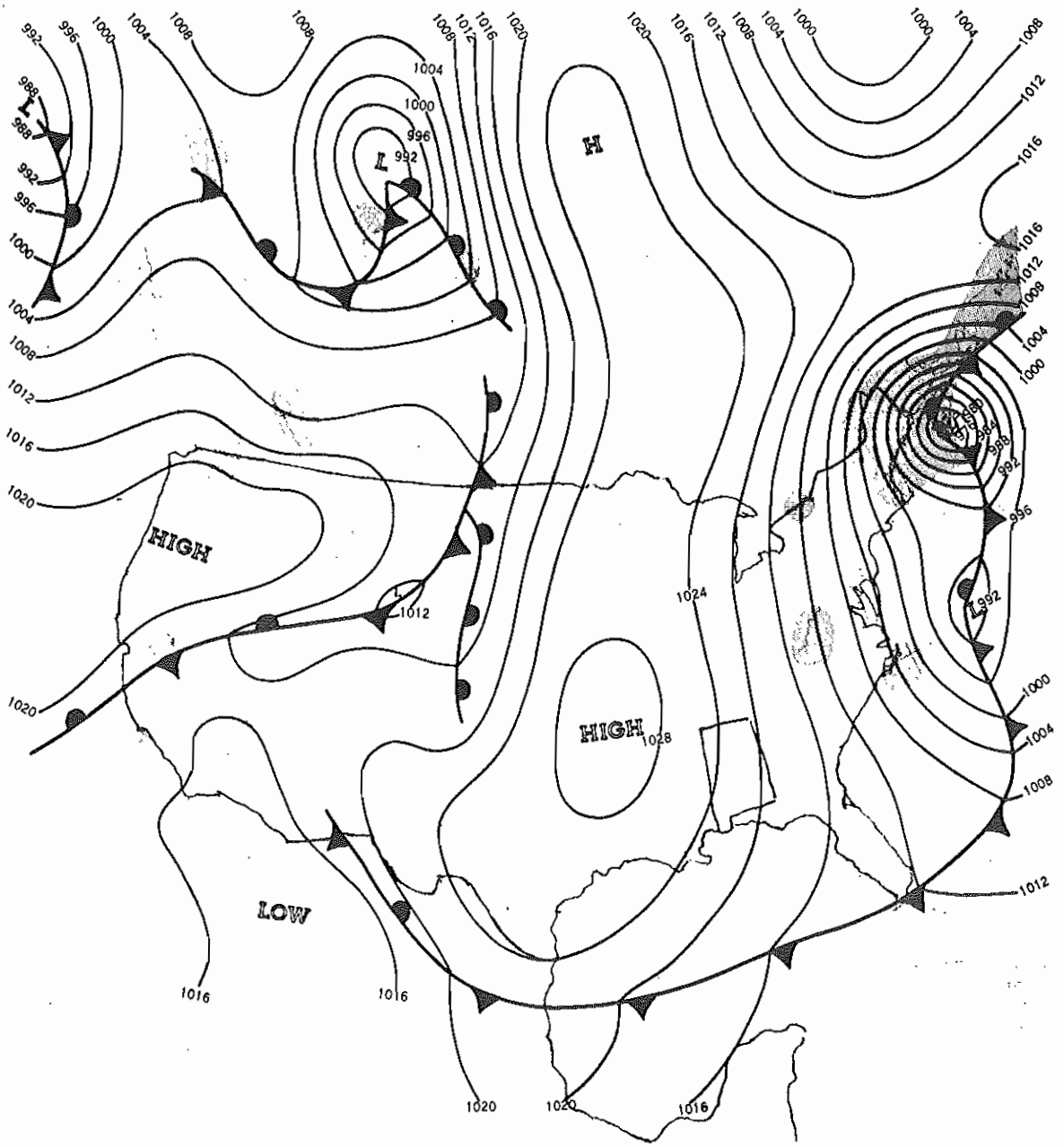
Two Typical Weather Patterns that Produce High Fire Danger

Figures 3 and 4 show two weather patterns which occurred during this study period that represent typical high fire danger days. The first is a cold frontal type which produces high winds, low humidities, and usually below normal temperatures. The second type produces rather low humidities, high winds, above normal temperatures, atmospheric instability, and is often a greater fire danger threat than the first. Upper winds must be conducive to suppress precipitation for either type, especially the second, to produce high fire danger.

Bad Burning Days and Weather Elements

To find a relation between weather elements and bad burning days, not all, but most of the bad burning days from January 1960 through February 1966 were collected and divided into relative humidity categories. Several interesting findings occurred. Table 2 emphasizes the relationship of weather elements to bad burning days. It is seen immediately that the majority of these bad burning days occurred during days when humidity was less than 35 percent. Days since accumulative one inch precipitation range from 5 days to 25 days, the average being 14 days. The average 24-hour wind speed varies from 3 to 16 mph, the average being 8 mph. Prevailing wind direction varies considerably, with the lower humidities predominately accompanied by northerly winds and all the higher humidities

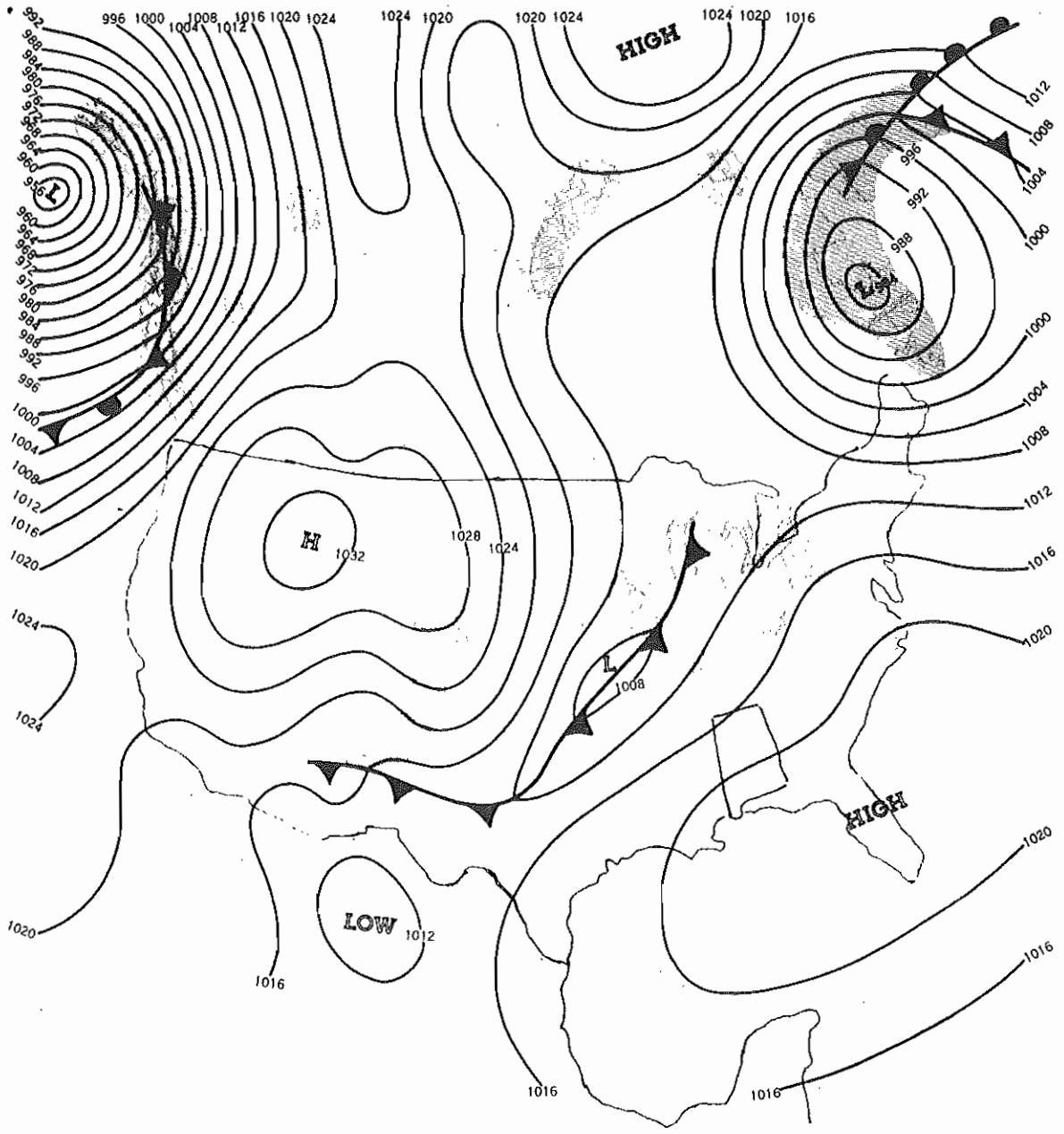
WEATHER CHART



12 00 P.M. October 29, 1963

FIGURE 3

WEATHER CHART



12:00 P.M. October 31, 1963

FIGURE 4

Table 2. BAD BURNING DAYS, JANUARY 1960 THROUGH FEBRUARY 1966

Lowest Relative Humidity	Days Since accum. one in. precip.	Avg. wind speed (mph)	Prevailing wind dir.	Maximum Temp. Anomaly	No. of fires	Acreage burned	Date
15 - 20%	16	15	NNW	- 8	253	10580	3-21-63
	18	5	N	- 1	223	6937	3-23-63
	19	5	S	+ 4	212	6080	3-24-63
	11	5	ENE	+10	233	7653	3-30-63
21 - 25%	7	12	WSW	+ 1	202	5382	3-22-60
	17	10	NW	- 5	120	5783	3-22-63
	10	5	ENE	+10	177	6831	3-29-63
	16	11	N	+10	183	7412	4-4- 63
26 - 30%	14	7	SE	+ 9	101	2554	12-5-60
	5	11	WNW	-15	99	5278	3-20-60
	12	3	N	+12	180	11212	3-31-63
	17	8	E	+ 6	144	8797	4- 5-63
31 - 35%	11	10	SSE	+ 7	111	4782	4-14-60
	13	6	SE	+ 9	194	10204	4- 1-63
	25	6	SW	+24	189	4214	2-13-62
36 - 40%	14	7	ESE	+ 7	105	3734	3-24-62
	15	7	S	+ 7	114	3232	3-29-62
	15	16	SE	+14	245	11476	2- 9-66
	14	6	S	+11	147	10537	4- 2-63
	15	6	SW	+16	128	4743	4- 3-63

accompanied by southerly winds. Maximum temperature anomalies (amount of temperature variation from normal maximum) varies from -15°F to +24°F with the mean being +6.4°F. All relative humidities above 30 percent show temperature anomalies of +7°F or above.

Fire Weather Programs and Problems

There are many problems in fire weather in addition to forecasting. For example, in many states the fire weather forecaster must train forecasters in the best use of forecasts. Often there is a communication difficulty in getting the forecast out to the field. Other problems exist varying with the particular location. The general consensus among fire weather forecasters is that often these type problems present the biggest obstacle to the fire weather programs. However, most fire weather programs have been in operation for a sufficient length of time to solve most of these problems, and, in all likelihood, those remaining will yield to experience and good service.

Fire weather services in the southeast have proven highly beneficial with the products having been put to positive use by recipient forestry agencies.

1. Reference - Mitchem, Richard A.; Forest Fires and Weather: A case study - 1963 Fall Fire Season; Alabama Department of Conservation, August 1963.